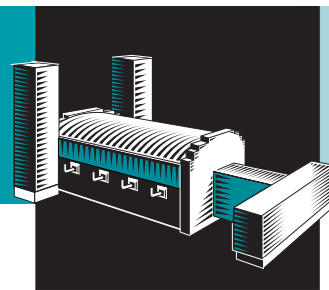


# GLASS

## Project Fact Sheet



## DEVELOPMENT OF A NOVEL FREQUENCY-SELECTIVE SOLAR GLAZING SYSTEM

### BENEFITS

- Minimizes direct solar heating through south-facing windows, reducing heating and cooling loads in commercial buildings and homes while providing ample light
- Reduces overall sunlight allowed into vehicles, keeping the interior cooler, reducing glare, and potentially reducing compressor weight and engine load
- Ideal for trapping heat in solar-thermal collection devices
- Lessens the need to burn fossil fuels for heating and cooling, reducing the amount of airborne pollutants and CO<sub>2</sub> released into the atmosphere
- Easily manufactured using current technologies

### APPLICATIONS

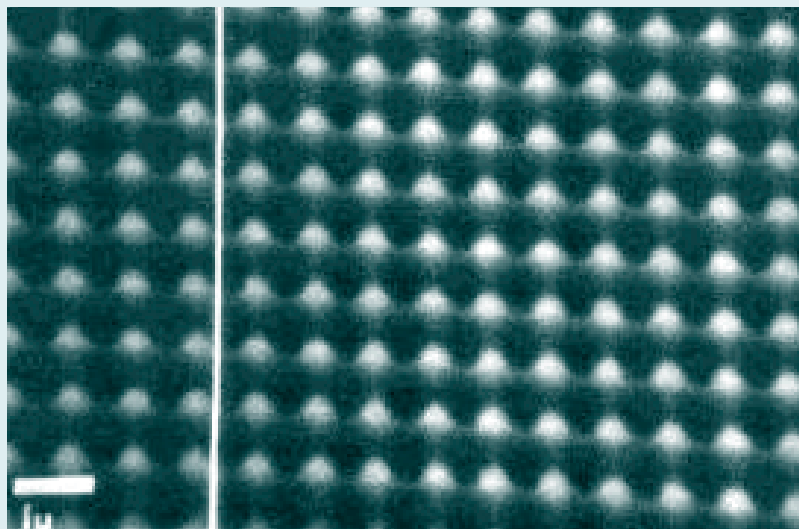
The frequency-selective solar glazing system is potentially applicable wherever a tinting agent is currently used to restrict transmission of sensible energy into an area. The automotive and building industries provide the most obvious opportunities, but the technology is also applicable in solar-thermal collectors where the technology's combination of frequency-selection and angular dependence make it ideal for trapping heat.

### NEW FREQUENCY-SELECTIVE GLAZING MATERIAL DECREASES OVERALL LIGHT WHILE REDUCING HEATING AND COOLING ENERGY REQUIREMENTS

Glazings that reduce the amount of solar energy entering through windows and skylights are essential to minimizing cooling loads. Consider, for example, an uncoated window of an automobile or a room. When the sun's rays enter the room through the window, ultraviolet, infrared, and most of the visible spectrum are transmitted through the window. Most of this energy is absorbed in the walls, floor, seats or furniture, and air of the space, while the rest is reflected back out the window. This absorbed energy now constitutes sensible heat energy that must be removed from the room by the cooling system.

A new glazing technology being developed by Orion Engineering shows promise for reducing absorbed energy in automobiles and buildings. The new glazing's characteristics make it ideal for trapping heat in solar-thermal collectors. While blocking convection and providing a frequency-selective radiation barrier, the glazing reduces energy loss to the environment. Orion's improved glazing can easily be manufactured using current technology, introducing a substantially new product to the glass industry and producing energy savings through decreased cooling loads.

### FREQUENCY-SELECTIVE GLAZING



The design of frequency-selective glass material uses cavities to produce surface-plasmon coupling, advancing the state-of-the-art in glazing.



## Project Description

**Goal:** Develop a novel glazing using surface-plasmon resonance to create a frequency-selective glass material suitable for use in automobile, building, and solar-thermal collector applications.

Current commercial light-filtering glazings apply a tinting film that restricts nearly all frequencies of incident light. This often hampers frequencies useful for daylighting. In contrast, Orion's system transmits desired frequencies of light with almost no reflection. The technology represents a state-of-the-art replacement for current tinting technologies, providing decreased full-spectrum light while efficiently transmitting visible light.

Other glass coatings designed to select frequencies use a complex laminate of materials that are applied to the substrate in multiple steps. Orion's technology involves a single thin layer of material, which should eliminate manufacturing steps and generate cost savings over these other technologies.

Orion Engineering, Inc., is developing this new technology with the help of a grant funded by the Inventions and Innovation Program in the Department of Energy's Office of Industrial Technologies.

## Progress and Milestones

- Create a working model of plasmon-photon interaction using mathematics software.
- Determine the precise manner in which changes to film thickness, glass thickness, hole size, hole spacing, and hole shape affect the frequency and amplitude of light transmitted through the glazing.
- Fabricate test samples at the University of Massachusetts Lowell Photonics Center.
- Validate model, develop engineering guidelines, and correlate the real-world behavior of the sample to the behavior predicted by the model.
- Determine which applications offer the greatest commercial potential, then pursue a commercialization strategy based on licensing the technology to industry.

## Economics and Commercial Potential

The frequency-selective glazing system can be frequency-tailored, permitting only visible light to pass. This selectivity can reduce the amount of sensible (heat) energy entering an area. Incident solar radiation of 500 watts/m<sup>2</sup> on a two square meter window with 20 percent reflectivity would contribute about 800 watts to the area, where a similar frequency-selective window with 80 percent reflectivity would reduce this contribution to only 200 watts, reducing cooling demand by 75 percent.

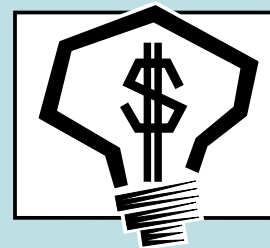
The estimated U.S. market for glass products in 1997 was \$26 billion, with a significant portion comprising flat-glass products like windows and automotive glass. As builders and the automobile industry become more conscious of energy efficiency, the proportion of flat-glass products employing energy-saving features will increase.

Orion's technology is ideally suited to meet the growing interest in renewable-energy technologies. The company's improved glazing could be used in solar-thermal collection systems to block convection and provide a frequency-selective barrier to reduce radiation loss to the environment.

## INDUSTRY OF THE FUTURE—GLASS

*In April 1996, several organizations representing the glass industry signed a compact with the Department of Energy (DOE) in an effort to encourage technological innovations that will reduce energy consumption, pollution, and production costs in the industry. The glass industry published a report entitled **Glass: A Clear Vision for a Bright Future**, which articulated the industry's vision of its future. This compact set the foundation for collaborative efforts between the industry and the Federal government. Signed by both key industry players and Department of Energy officials, it was a formal commitment to align DOE'S limited resources to meet the challenges identified in the vision.*

**OIT Glass Industry Team Leader: Elliott Levine (202) 586-1476.**



The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and conduct early development. Ideas that have significant energy savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

## PROJECT PARTNERS

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